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METHOD STATEMENT

REGARDING:

- TEMPORARY DIAPHRAGM WALL
- PERMANENT DIAPHRAGM
- SOIL TREATMENT BY
  VIBRO COMPACTION

PRELIMINARY WORK PROCEDURES

1. TEMPORARY DIAPHRAGM WALL

1.1 Work platform

This is identified by a 12 to 15 m wide strip, along the diaphragm centerline, made by material able to support the weight of our crawled cranes (1,5 to 2 kg/cm^2), and, at least 1,5 m above the water table. Surface should be reasonably flat and in plain.

Two guide-walls will be made in lightly reinforced concrete, to be spaced apart of a distance equal to the width of the excavating tool plus 8 cm, and having the following dimensions: 25 cm thick 120 cm deep. The guide walls would guarantee the correct planimetric development of the cut-off.

1.2 Excavating equipment

The excavation will be made by grab.

Digging of the trench by grab will require either an hydraulically or mechanically operated grab of 0,60 m thickness, assembled on a crawler crane type Link Belt LS-318, 70 tons. In order to ensure a control of the trench geometry and possible deviations from verticality we would employ the following instrumentation:

- inclinometer, for measuring deviations from x and y axis.

The data collected by the sensors would flow to the recording and control station (a computer), where they will be processed, and visualize on an electrosensitive paper a graph showing the geometry of the excavation in the direction of the axis being measured.

1.3 Drilling fluid and backfilling material

The temporary diaphragm wall will be of the self hardening mud type, where a single bentonite-cement slurry combines the short-term rheological functions of a drilling mud and the long-term requirements of the backfilling material.

Therefore the construction procedure is based on the use of a grout fulfilling a double role:

a) during excavation it behaves as a conventional bentonite mud (even if containing cement), with the task to ensure the stability of the trench walls

b) further on, the same grout (modified to a certain extent by addition of soil particles and drainage in granular soils) forms the final structure with the required properties in terms of permeability, strength and deformability.

The overlapping between primary and secondary panels, 20-25 cm approx., accomplished before setting of the slurry in the former ones, brings to the formation of a virtually jointless impervious curtain.

The composition of the self hardening grout will be defined according to the results of preliminary laboratory tests on trial mixes prepared with the actual components to be used in the site (cement, bentonite and water).

1.4 Mixing plant and circuits

The plant that would be used for the preparation of the W/B/C mix is automatic mixer, IM-20 type, 20 m^3/h capacity, which shall:

- mix water and bentonite in high speed mixers
- send the W/B slurry to stocking ponds where it will be kept stirred to avoid segregation of bentonite. The slurry will stay here for at least 12 hours in order to ensure a good degree of hidration
- add cement to the slurry coming from the stocking pond and mix it in a separate high speed mixer
- pump the final slurry to the part of trench under excavation
- the temperature of the water has to be as low as possible, coming directly from the wells.

1.5 Sequence of operations

The construction of the cut-off wall implies the alternate sequence of two stages of operations:

- Preparation of W/B slurry and stocking it in quantity suitable with the foreseen volume of excavation per day. Sampling at regular intervals of the mix will keep under control: unit weight, bleeding, viscosity, start of setting time.
- Adding of cement to W/B slurry.
- Excavation of primary panels positioned at regular intervals along the cut-off axis, in presence of W/C/B mix.

- Excavation of a series of intermediate panels, in-between the primaries, ensuring the continuity of the wall.
  Interlocking between primary and intermediate panels is obtained by scraping the ends of panels already constructed, which still have a soft plastic consistency, thus overlapping for a minimum of 20 cm.
  The plastic cut-off shall extend to the specified depth and penetrate into the impervious layer of clay.
- Checks of the panels geometry by using the instrumentation system described in point 1.2.

With this method, we have assumed an average rate of production of 250 m^2 per day/crane, barring unexpected geological conditions. We have foreseen to work on double shift without interruptions.

2. PERMANENT DIAPHRAGM

The permanent diaphragm wall will be formed by plastic concrete cast after excavation of primary and secondary panels under a bentonite slurry.

2.1 Excavation

Method of excavation is similar to the one described in para 1. Also the preparation of W/B slurry will follow the same procedures since the plant to be used is still the IM 20 or similar.

2.2 Placing the plastic concrete

Once the excavation of a panel has been completed, a tremie-pipe will be lowered into the trench, and its bottom end (temporarily plugged by rags or paper) will be stopped at about 0,5 m from the final elevation of the excavation. At the top of the tremie-pipe a large funnel would be fitted to facilitate the pouring of plastic concrete.
The composition of plastic concrete will be defined according to the results of preliminary lab. tests on trial mixes prepared with component materials (cement, bentonite and water) to be actually used on site.

As regards the bentonite mud used for the excavation (to be then replaced by plastic concrete), a newly mixed mud, before use will have the following characteristics:

- density in the order of 1,02 to 1,05
- Marsh viscosity (base 1 litre) greater than 35 seconds

- filtrate less than 30 cm^3
- cake thickness less than 3 mm.

The mud recovered during excavation may be used after adequate treatment in order to fulfill the following requirements:

- density less than 1,20
- Marsh viscosity less than 90 seconds
- filtrate less than 40 cm3
- cake thickness less than 5 mm
- sand content less than 5%

The upper grain size limit of gravel should be 20 mm.

The concrete mix would be partially prepared at the IM-20 plant by mixing cement, bentonite, water, this mix would then be pumped inside the truck-mixer of the Main Contractor, already loaded with aggregates.

While pouring the plastic concrete into the tremie-pipe, this would be gradually lifted, having care of keeping its bottom end always sunk into the fluid concrete mass. During the pouring operation a pump situated at the top of the trench will transfer the W/B slurry (disloged by the raising concrete) used for the excavation, to the stocking pond for regeneration.

Adjustments to the above procedures could be made on site, or whenever a way of speeding up the operations may be found and agreed, keeping safe the requirements of the Technical Specifications.

2.3

Requirements for working platform and guide walls are similar to those of temporary diaphragm construction.

3. SOIL TREATMENT BY VIBRO COMPACTION

This paragraph describes soil treatment Vibrofloating works for Bill of Quantities No. 11 a (Foundation Treatment - Basic Solution: 217.000 lin. m).

For carrying out the required soil improvement works we are suggesting to apply the so-called Vibro Compaction soil densification process and to employ our company's S-Vibrator, which is of the 120 kW category and allows an efficient in-situ densification at triangular grid spacings of 2,8 m as specified.

Final grid spacing, densification procedure and type of equipment required for the soil improvement works shall be established on basis of the trial test specified.

Since detailed subsoil information will only be available after performance of the Geotechnical Investigation programme, still to be carried out, and since we are having at present only a general geological description of the site from the tender specifications we are assiming that the subsoil, which will be subject to soil densification, will contain less than 10 to 12% fines (passing 200). Backfill material which will be required for the Vibro Compaction process shall be of similar quality to achieve an efficient soil densification and will be taken either from site surface around the compaction point or, in case of imported material, from temporary stock piles at distances not further than 50 m away from our operation places.

Where subsoil, at the soil treatment zones, especially in the closure dam area, consists of loamy sandy silt, as indicated in the schematic geological cross section at page 4 of the Specifications, or of fine silty sand with D50 of 0,040 m, as shown in the table at page 10, such material may have to be excavated and replaced by suitable, selected fill according to the above stated limits. A decision on this can only be made after receipt of the results obtained by the geotechnical investigation still to be carried out.

With regard to item 11.7.1.3. "Platform Elevation for Vibroflotation Works" of Division No.11 (Soil Treatment) we would like to state that with the vibrator types used by our company an efficient densification effect on the subsoil is achieved and that only a final surface compaction using conventional vibratory rollers,after relevelling site surface, is required. The Vibro Compaction process therefore can, without any problems on the efficiency in the upper 2 m of treatment, be carried out from a level close to the proposed elevation of concrete structure foundations.

For Vibro Compaction works to be carried out at the 5 H to 1 V slope at the embankment close to the lock area we would require a working platform cut into temporary berms.

The Vibro Compaction trials should be carried out from an elevation similar to that of the future operation level to allow correct comparison and interpretation of test results. One trial test at one treatment area will take approx. one week. We have all together foreseen a trial period of approx. one month.

The amount of Vibro Compaction works to be carried out may vary, since the compaction point spacings will only be established after performance of field trials.

As quality control we are foreseeing the performance of so-called Dutch Cone Tests (CPT) as specified, employing a 20 ton testing machine. For interpretation of test results we are suggesting the commonly known cone resistance rel. density correlation of Schmertmann published in 1978.

We have foreseen to carry out the Vibro Compaction works in double shift operations employing 2 Vibro units.

We would like to state at this occasion that we believe to have the expertise as well as the necessary equipment to carry out the required soil improvement works.

DIAPHRAGM WALLS AND STRIP PILES

EXCAVATION BY HYDRAULIC GRAB:

- Crane 70 tons LS 318 type	no. 2
- Crane 40 tons LS 318 type	no. 1
- RP 5, hydraulic and equiped for hydraulic grab	no. 2
- Hydraulic grab 600 m/m K 400 type	no. 3
- Hydraulic grab 800 m/m K 2500 type	no. 2
- Mechanical grab 600 m/m K 2500 type	no. 2
- Kit of jaws 800 m/m K 4000 type	no. 2
- Kit of jaws 800 m/m K 2500 type	no. 2
- Slurry plant IM 20	no. 2
- Mud hopper + Magnum 1 pump	no. 2
- Mixer R/3000	no. 2
- Desanding plant	no. 3
- Moro 1200 electropump	no. 3
- Workshop container	no. 1
- Verticality control system: inclinometer	no. 1
- Flygt water pumps 2125 ÷ 2151	no. 13
- Welding plant	no. 2
- Mocompressor 5000 l capacity	no. 1
- Wheel loader cat 920	no. 1
- Fork lift	no. 1
- Site transport means	no. 5
- Funnel and trimie pipes	no. 2 (set)
- Accessories and spares	- as required

Total weight of equipment: 340 tons

Total volume of equipment: 695 m^3

Market value of equipment: 3.200 mill. LIT

VIBROFLOTATION

- Crane 60/70 tons capacity	no. 2
- Crane 40 tons capacity	no. 1
- Wheel loader	no. 1
- Electric generator 250 kVA	no. 3
- Dutch cone apparatus	no. 1
- S-type vibrators	no. 5
- Water pump	no. 10
- Starter switch	no. 5
- Distribution box	no. 2
- Work-shop container	no. 1
- Accessoires and spares	- as required
- Site transport means	no. 3

Cranes, if compatible with general work programme, could be supplied partially or totally by the diaphragm wall site.

Total weight equipment : 240 tons

Total volume of equipment: 500 m^3

Market value of equipment: 2.200 mill. LIT